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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Shum et al.

Application No. 09/338,176

Filed: June 22, 1999

Confirmation No. 1062

For: METHOD AND APPARATUS FOR RECOVERING A THREE-DIMENSIONAL SCENE FROM TWO-DIMENSIONAL IMAGES

Examiner: Allen C. Wong

Art Unit: 2613

Attorney Reference No. 3382-52053

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Attorney for Applicant(s) Stephen A. Wight

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This brief is in furtherance of the Notice of Appeal filed September 26, 2003. The fee required under 37 CFR 1.17(c) is enclosed.

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I. REAL PARTY IN INTEREST

The real party in interest is Microsoft Corporation, by an assignment from the inventors recorded at Reel 010184, Frame 0776.

II. RELATED APPEALS AND INTERFERENCES

Currently, there are no other pending appeals or interferences known to appellant, the appellant's legal representatives, or assignees, which will directly affect or be directly affected by or have a bearing on the pending appeal.

III. STATUS OF CLAIMS

Claims 1-37 remain rejected under 35 U.S.C. § 102(e) as being anticipated by *Moriya* et al., U.S. Pat. No. 6,046,745 ("*Moriya*") and remain appealed in conjunction with which the subject Appeal Brief is being filed.

IV. STATUS OF AMENDMENTS

A qualifying amendment was filed on January 30, 2003 and was entered. An amendment after final rejection was filed on August 7, 2003 but the amendment was not entered. Thus, for the purpose of Appeal the claims will be presented as they appeared after the entry of the first amendment filed on January 30, 2003.

V. SUMMARY OF THE INVENTION

The field of computer graphics has made significant strides in recent years by improving upon the processing required to recreate real life objects in terms of their motion, color and other appearance characteristics. One of the challenges in faithfully depicting real life objects is that in real life objects appear in terms of three dimensions (3D) (e.g., in x, y, and z dimensions), whereas the capture and display of images of such objects may be in terms of two dimensions (2D) (e.g., in x and y dimensions). Thus, the specification describes an invention which generally relates to three-dimensional computer graphics, and, more particularly, relates to reconstructing a realistic three-dimensional scene from a sequence of two-dimensional images. *See,* specification at page 1, lines 5-7.

A 3D scene that is displayed to a user may be generated from a synthetic 3D scene, which is generated by a computer, or a real scene, which can be captured using a camera (e.g., video camera). *See,* specification at page 2, lines 1-9. For either synthetic or real scenes, there are different parameters associated with the scene, such as the 3D structure associated with any object in the scene and the camera movement (e.g., rotation and translation) for a real or imaginary camera capturing the scene. *Id.* Thus, it is desirable to automatically recover the structure of a 3D scene together with 3D camera positions from a sequence of images (e.g., video images) acquired by an unknown camera undergoing unknown movement. *Id.* Once a 3D structure is recovered it can be used to generate a complete 3D computer model of the object, which can be used to illustrate a different perspective of the object in 3D space. *See,* specification at page 1, lines 23-29. On a 2D display, different perspectives may then be used to show different lighting and shadowing changes in order to create a perception of viewing an object in 3D. *Id.*

Recovering a 3D scene from a sequence of images is often accomplished using structure-from-motion (SFM) algorithms. *See,* specification at page 2, lines 10-21. Over the years, various SFM have been proposed and studied extensively because of their applications in robotics, video editing and image based modeling and rendering. *Id.* Some important aspects of SFM calculations include identifying multiple feature points in images, using a long baseline, and efficient bundle adjustment. *Id.* A feature point is any point in the image that can be tracked well from one frame to another. *Id.* Typically, corners of an object are easily identifiable and are considered good feature points. *Id.* The base line is associated with the motion of a camera in relation to an object depicted in an image. *Id.* Bundle adjustment is a non-linear minimization process that is typically applied to the entire collection of the input frames and features of the input image stream. *Id.* Essentially, bundle adjustment is a non-linear averaging of the features over the sequence of input frames to obtain the most accurate 3D structure and camera motion. *Id.*

There are, however, problems with conventional 3D reconstruction using SFM. For example, bundle adjustment of long sequence of input frames may be computationally expensive if it involves processing the entire sequence of input frames and features at once. *See*, specification at page 2, line 22 – page 3, line 2. Additionally, the bundle adjustment used in 3D reconstruction requires a good initial estimate of both the 3D structure and the camera motion.

Id. The complexity of interleaving bundle adjustment for each iteration step may be measured as a function of the number of feature points and the number of frames being bundled. *Id.* Thus, bundle adjustment computed over a long sequence of input frames is time consuming and slows the entire 3D reconstruction. *Id.* For this reason, most systems use relatively short or sparse set of image sequences. *Id.* In practice, however, structure from motion (SFM) is often applied to a long sequence of images in order to achieve better 3D reconstruction. *Id.*

To overcome the shortcomings of conventional 3D reconstruction, a long sequence of frames or images may be divided into a number of smaller segments with each segment comprising a subset of the longer sequence of frames. *See,* specification at page 3, lines 10-14. A 3D reconstruction can then be performed on each segment individually. *Id.* Later on, the 3D reconstruction of all the segments can be combined together through an efficient bundle adjustment to complete the 3D reconstruction for entire sequence of input frames. *Id.* Since the complexity and hence, the computational cost of 3D reconstruction and bundling are directly affected by the number of frames being processed, segmenting a longer sequence of frames is one manner in which these costs can be significantly reduced. *Id.*

Further improvement may be realized by reducing the number of frames in each sequence by creating virtual key frames to encode the 3D structure for each segment. *See,* specification at page 3, lines 15-20. Also, the segmenting of the sequence of frames may be made more efficient by generating segments wherein the number of frames per segment is based on the number of feature points present in each frame in the segment. *Id.* at 21-27. Thus, each segment may vary in the number of frames contained within. *Id.* For example, any frame that has less than a threshold number of feature points may be moved to a different segment. *Id.* This approach to segmenting balances the desire for a long baseline and a small tracking error. *Id.*

VI. <u>ISSUES</u>

The single issue presented for review is whether claims 1-37 (as amended in the amendment filed on January 30, 2003) are patentable under 35 U.S.C. § 102(e) over *Moriya*.

VII. <u>GROUPING OF CLAIMS</u>

Independent claims 1, 9, 23, 31, 36 and 37 and any of their respective dependent claims each contain different limitations that further distinguish each from the prior art. However, to

facilitate the Board's consideration of this appeal, Applicants group the claims for the purposes of this appeal as follows:

For the purposes of this appeal only, patentability of claims 2-8 and 23-37 stand or fall with the patentability of claim 1 and patentability of claims 10-22 stand or fall with the patentability of claim 9.

VIII. ARGUMENT

Rejection of claims under 35 U.S.C. § 102 (e)

Applicants respectfully request reversal of the Examiner's rejection of claims 1-37 under 35 U.S.C. § 102(e) as being anticipated by *Moriya*. To anticipate a claim, the reference must teach or suggest each and every element of the claim. *See* MPEP § 2131. More particularly, "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California,* 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). In this case, the *Moriya* reference cited by the Examiner fails to either explicitly or implicitly teach or suggest each and every element of the rejected claims.

A. The cited reference, *Moriya* does not teach or suggest each and every element of independent claims 1, 23, 31, 36 and 37

Claims 1-8

Claim 1 is directed to a method of generating a three-dimensional scene from a sequence of two-dimensional images. More particularly, claim 1 recites:

> A method of recovering a three-dimensional scene from two-dimensional images, the method comprising:
> providing a sequence of images;
> dividing the sequence of images into segments;
> performing three-dimensional reconstruction for each segment individually; and
> combining the three-dimensional reconstructed segments together to recover a three-dimensional scene for the sequence of images. (Emphasis added).

Sub-figures constituting a single basic figure as taught by Moriya do not teach or suggest a method of recovering a three-dimensional scene from a sequence of two-dimensional images

by "providing a sequence of images" and "dividing the sequence of images into segments." The Examiner relies on element 4038 of FIG. 40 of *Moriya* described at column 29, lines 28-31, which refers to "features of a basic figure 4038 constituting a three-dimensional model concerning sub-figures such as points, lines, planes, type of a cube, a classification of a linear line and a curved line or the like." *See e.g.,* Office action mailed April 23, 2003, at page 2 (alleging that column 29, lines 28-31 of *Moriya* teaches or suggest "dividing the sequence of images into segments" and rejecting claims 1-37). The Applicants respectfully disagree.

Among other things, *Moriya* is directed to methods and apparatus for generating 3D models and more particularly to instantaneously and interactively determining a 3D structure and camera parameters of an object from a single two dimensional image not a "sequence of images" as claimed. For instance, the Abstract section of *Moriya* states:

> Disclosed is an image processing arrangement to determine camera parameters and make a three-dimensional shaped model of an object from a single frame picture image in an easy manner in an interactive mode. (Emphasis added).

In fact, the specification of *Moriya* is replete with statements to the effect that the methods and apparatus taught therein are particularly advantageous over the prior art because 3D structure and camera parameters associated with an object may be extracted by processing a single 2D image. For example, the Summary of the Invention section of *Moriya* at column 3, lines 49-52 state as follows:

> Yet a further object of the preferred embodiment of the present invention is to provide a simplified method/arrangement for determining camera parameters from a single frame picture. (Emphasis added).

The fact that *Moriya* is directed to processing of a single 2D image or frame as opposed to "a sequence of images" is made clearer in the passages relied on by the Examiner for rejecting the subject claims. The passages of *Moriya* relevant to describing FIG. 40 and relied on by the Examiner state at column 29, lines 31-38 as follows:

> A unique and novel advantage of the device/procedure of the present invention is that camera parameters and three dimensional CG model data can be determined directly using only a single actual image and further, data determined with the present invention can be cooperatively processed with other (complementary) CG model making software 4040 such as a general-used CAD device. (Emphasis added).

Moreover, the passage goes on distinguish what *Moriya* clearly considered to be the invention from those processes that may rely on multiple image frames (e.g., the recited "sequence of images"). The relevant passage at column 29, lines 46-52 states:

> It is important to note that within the present invention, determination of camera parameters, extraction of 3-D image data of objects and determination of 2-D image data are all preferably and advantageously conducted using a single frame picture image (i.e., as opposed to having multiple differing frames to determine camera positions.)

Thus, at best, "features of a basic figure 4038 constituting ... sub-figures such as points, lines, planes, type of a cube, a classification of a linear line and a curved line or the like" as taught by *Moriya* suggests that a single image (i.e., basic figure) may constitute sub-figures, whereas the claim 1 recites "dividing a *sequence* of images into *segments*." FIG. 3 of the application clearly shows an input "sequence of images" having multiple images (60) and being divided into "segments" (68) wherein each segment comprises multiple frames which are a subset of the input "sequence of images." For instance, the specification at page 8, lines 7-14 describes "dividing a *sequence* of images into *segments*" with reference to FIG. 3 as follows:

> <u>The sequence of images are divided into segments 68, which are illustrated as segment 1 through segment N, where N is any positive integer. Each segment contains a certain number of frames and the number of frames in each segment may vary in length.</u> For example, segment 1 may contain 100 frames whereas segment N contains 110 frames. As described further below, the number of frames in a segment depends on the ability to track feature points in each frame. Thus, each frame in a given segment will have a minimum number of feature points that are trackable to a base frame in that segment. (Emphasis added).

"A sequence of images" as clearly illustrated in FIG. 3 and defined in the specification is a series of multiple related images and the specification clearly teaches that it is this "sequence" that is divided into "segments," wherein "each segment contains a certain number of frames and the number of frames in each segment may vary in length." *See,* specification page 8, lines 8-10. Thus, adapting the Examiner's view would have the effect of ignoring not only the meaning provided in the specification for the word "sequence" and hence, the phrase "dividing the *sequence* of images into *segments*" but it would also ignore their ordinary meaning. However, the "ordinary and customary meaning" of claim terms and phrases cannot be ignored when construing a claim. *See e.g., CCS Fitness, INC., v. Brunswick Corp.,* 288 F.3d 1359 at 1366, 62

U.S.P.Q.2d (BNA) 1658 at 1669 (Fed. Cir. 2002) ("Generally speaking, we indulge a 'heavy presumption' that a claim term carries its ordinary and customary meaning"). The search for the "ordinary and customary meaning" of a claim term begins with a general English language dictionary. *See e.g.,* Id. ("Sensibly enough, our precedents show that dictionary definitions may establish a claim term's ordinary meaning").

In this case, the Examiner would have us believe that a single "basic figure 4038 constituting… sub-figures such as points, lines, planes, type of a cube, a classification of a linear line and a curved line or the like" is the same as "dividing the *sequence* of images into *segments*", which completely contradicts the ordinary meaning of the term "sequence." For instance, the ordinary meaning of the term "sequence" is provided as "a continuous or connected series: as **a.** a group of similar or related elements," which clearly and unambiguously excludes a single element from forming a "sequence." *See, Webster's 3d New Int'l Dictionary* 2071 (3d ed. 1993).

Furthermore, the claim 1 recites "dividing the sequence of images into *segments,*" wherein "each segment contains a certain number of frames and the number of frames in each segment may vary in length." *See,* specification page 8, lines 8-10. Thus, the "segments" derived by "dividing the sequence of images" comprises "a certain number of *frames*" not "sub-figures such as points, lines, planes, type of a cube, a classification of a linear line and a curved line or the like" as recited in *Moriya*. Here, the Examiner's interpretation directly contradicts the definition provided in the specification, which is not acceptable. Even if a broad interpretation of the ordinary meaning of "segments" may include "sub-figures" of *Moriya*, such an ordinary meaning may be overcome by the definition clearly set forth in the specification. *See, CCS Fitness, INC.* at 1366 ("the claim will not receive its ordinary meaning if the patentee acted as his own lexicographer and clearly set forth a definition of the disputed claim term in either the specification or the prosecution history"). The term "segments" has been unambiguously defined as containing "a number of frames." *See e.g.,* specification at page 7, lines 13-17. Thus, dividing a single image into component elements "such as points, lines, planes, type of a cube, a classification of a linear line and a curved line or the like" as taught by *Moriya*, is not the same as "dividing the *sequence* of images into *segments*" containing a subset of the longer sequence to simplify the processing necessary to reconstruct a three-dimensional scene from a sequence of two-dimensional images.

Moriya makes it abundantly clear that its methods and apparatus are directed to processing a single image. Thus, *Moriya* has no need for and thus does not teach or suggest "providing a *sequence* of images" and "dividing the *sequence* of images into *segments*." Even if one was to argue that the passages cited above from *Moriya* were directed to describing the only preferred embodiment that cannot overcome the fact that *Moriya* fails to teach or suggest "providing a *sequence* of images" and "dividing the *sequence* of images into *segments*." Adapting the Examiner's definitions for the phrase "sequence of images" and the term "segments" would directly contradict the definitions clearly set forth in the specification. Furthermore, in case of the term "sequence," Examiner's definition would also contradict the "ordinary and customary" meaning of the term.

Since *Moriya* fails to teach or suggest each and every element of claim 1, the rejection of claim 1 under 35 U.S.C. § 102 (e) over *Moriya* is improper and claim 1 in its present form should be patentable. Claims 2-8 depend on claim 1 and at least for the reasons set forth regarding claim 1 they also should clearly be patentable over the cited reference.

Claims 23-30

Amended claim 23 is also directed to a method of recovering a three dimensional scene from a sequence of two-dimensional images. More particularly, claim 23 recites:

> A method of recovering a three-dimensional scene from a sequence of two-dimensional frames, comprising:
>
> (a) <u>segmenting the sequence of two-dimensional frames</u>;
>
> (b) identifying feature points in at least a first base frame in a first segment;
>
> (c) analyzing a second frame in the segment to identify the feature points in the second frame;
>
> (d) determining whether a threshold number of feature points from the base frame are identified in the second frame;
>
> (e) if a threshold number of feature points are identified in the second frame, adding the second frame to the segment; and
>
> (f) repeating (c) through (e) for subsequent frames until the number of feature points in a frame falls below the threshold number. (Emphasis added).

As amended, claim 23 recites "A method of recovering a three-dimensional scene from a sequence of two-dimensional frames, comprising: *segmenting the sequence of two-dimensional*

frames." (Emphasis added). Thus, at least for the reasons set forth above with regard to claim 1, claim 23 and its dependent claims 24-30 should also be patentable.

Claims 31-35

Claim 31 is directed to an improvement in the method of recovering a three-dimensional scene from a sequence of two-dimensional frames. More particularly, claim 31 recites as follows:

> In a method of recovering a three-dimensional scene from a sequence of two-dimensional frames, an improvement comprising dividing a long sequence of frames into segments and reducing the number of frames in each segment by representing the segments using between two and five representative frames per segment, wherein the representative frames are used to recover the three-dimensional scene and remaining frames are discarded so that the three-dimensional scene is effectively compressed. (Emphasis added).

Claim 31 recites "In a method of recovering a three dimensional scene from a sequence of two-dimensional frames, an improvement comprising *dividing a long sequence of frames into segments.*" Thus, at least for the reasons set forth above with regard to claim 1, claim 31 and its dependent claims 32-35 should also be patentable.

Claim 36

Claim 36 is directed to a computer-readable medium having computer-executable instructions for performing a method of recovering a three-dimensional scene from a sequence of two-dimensional frames. More particularly, claim 36 recites as follows:

> A computer-readable medium having computer-executable instructions for performing a method comprising:
> providing a sequence of two-dimensional frames;
> dividing the sequence into segments;
> calculating a partial model for each segment that includes three-dimensional coordinates and camera pose for features within the frames;
> extracting virtual key frames from each partial model, the virtual key frames having three-dimensional coordinates for the frames and an uncertainty associated with the frames; and
> bundle adjusting the virtual key frames to obtain a complete three-dimensional reconstruction of the two-dimensional frames. (Emphasis added).

Claim 36 recites "providing a sequence of two-dimensional frames" and "dividing the sequence into segments." Thus, at least for the reasons set forth above with regard to claim 1, claim 36 should also be patentable.

Claim 37

Claim 37 is directed to an apparatus for recovering a three dimensional scene from a sequence of two-dimensional frames by segmenting the sequence of frames. More particularly, claim 37 recites as follows:

> An apparatus for recovering a three-dimensional scene from a sequence of two-dimensional frames by segmenting the frames, comprising:
> means for capturing two-dimensional images;
> means for dividing the sequence into segments;
> means for calculating a partial model for each segment that includes three-dimensional coordinates and camera pose for features within the frames;
> means for extracting virtual key frames from each partial model; and
> means for bundle adjusting the virtual key frames to obtain a complete three-dimensional reconstruction of the two-dimensional frames. (Emphasis added).

Claim 36 recites "means for dividing the sequence into segments." Thus, at least for the reasons set forth above regarding claim 1, claim 37 should also be patentable.

B. The cited reference, *Moriya* does not teach or suggest each and very element of independent claim 9

Claim 9 recites a method of recovering a three-dimensional scene from a sequence of two-dimensional images. More particularly, claim 9 recites as follows:

> A method of recovering a three-dimensional scene from two-dimensional images, the method comprising:
> identifying a sequence of two-dimensional frames that include two-dimensional images;
> dividing the sequence of frames into segments, wherein a segment includes a plurality of frames;
> for each segment, encoding the frames in the segment into at least two virtual frames that include a three-dimensional structure for the segment and an uncertainty associated with the segment.

Sub-figures constituting a single basic figure as taught by Moriya do not teach or suggest a method of recovering a three-dimensional scene from a sequence of two-dimensional images

by "dividing the sequence of frames into segments, <u>wherein a segment includes a plurality of frames</u>." As he did with regard to claim 1, the Examiner relies on element 4038 of FIG. 40 of *Moriya* described at column 29, lines 28-31, which refers to "features of a basic figure 4038 constituting a three-dimensional model concerning sub-figures such as points, lines, planes, type of a cube, a classification of a linear line and a curved line or the like." *See e.g.,* Office action mailed April 23, 2003, at page 2 (using the same rationale for rejecting both claim 1 and claim 9). As noted above, in the argument with regard to claim 1, *Moriya* is focused on processing a single frame and thus, has no need for and does not teach or suggest "dividing the *sequence* of frames into *segments*, wherein a segment includes a plurality of frames." First of all, the specification makes it amply clear that "segments" comprise "a certain number of *frames*." *See,* specification page 8, lines 8-10. However, the additional limitation of claim 9 which recites "wherein a segment includes a plurality of frames" makes it abundantly clear that segments comprise of frames not "sub-figures such as points, lines, planes..." Thus, "dividing the sequence of frames into *segments, <u>wherein a segment includes a plurality of frames</u>"* cannot be anticipated by *Moriya*'s "sub-figures such as points, lines, planes, type of a cube, a classification of a linear line and a curved line or the like."

According to the Examiner, "sub-figures such as points, lines, planes..." are "segments" into which "a basic figure" is divided. Adopting, this interpretation would simply ignore the claim limitation that "a segment includes a plurality of frames" or it would mean that "sub-figures such as points, lines, planes..." are the same the claimed "plurality of frames." However, claim 9 itself claims frames as something larger than "sub-figures such as points, lines, planes..." In fact, claim 9 specifies frames "as a sequence of two-dimensional *frames that include two-dimensional images*." A plain reading of claim 9 will not allow the interpretation relied on by the Examiner. Thus, the rejection of claim 9 under 35 U.S.C. § 102 (e) over *Moriya* is improper for this reason in addition to the arguments set forth above regarding claim 1.

IX. CONCLUSION

In light of the arguments presented above the rejection of claims 1-37 should be reversed and all claims passed to issue.

Respectfully submitted,

KLARQUIST SPARKMAN, LLP

By ______________________
Stephen A. Wight
Registration No. 37,759

One World Trade Center, Suite 1600
121 S.W. Salmon Street
Portland, Oregon 97204
Telephone: (503) 226-7391
Facsimile: (503) 228-9446

cc: Patent Group Docketing Dept. (127693.1)
KS Paralegal

APPENDIX A

CLAIMS ON APPEAL

1. A method of recovering a three-dimensional scene from two-dimensional images, the method comprising:

providing a sequence of images;

dividing the sequence of images into segments;

performing three-dimensional reconstruction for each segment individually; and

combining the three-dimensional reconstructed segments together to recover a three-dimensional scene for the sequence of images.

2. The method of claim 1 wherein performing includes creating virtual key frames for each of the segments, wherein the virtual key frames are only a subset of the images in a segment but are a representation of all of the images in that segment.

3. The method of claim 1 wherein the images contain feature points and a number of images included in a segment is based upon a number of feature points tracked between the images in that segment.

4. The method of claim 1 wherein performing further includes:

performing a two-frame structure-from-motion algorithm to create a plurality of local models for each segment; and

combining the plurality of local models by eliminating scale ambiguity.

5. The method of claim 4 further comprising:

bundle adjusting the combined local models to obtain a partial three-dimensional model for each segment;

extracting virtual key frames from the partial three-dimensional model, wherein the virtual key frames include three-dimensional coordinates for the images and an associated uncertainty; and

bundle adjusting all segments to obtain a complete three-dimensional model.

6. The method of claim 1 further including:

identifying feature points in the images;

estimating three-dimensional coordinates of the feature points; and

estimating a camera rotation and translation for a camera that captured the sequence of images.

7. The method of claim 1 wherein combining includes performing a non-linear minimization process across the different segments through bundle adjustment.

8. A computer-readable medium having computer-executable instructions for performing the method recited in claim 1.

9. A method of recovering a three-dimensional scene from two-dimensional images, the method comprising:

identifying a sequence of two-dimensional frames that include two-dimensional images;

dividing the sequence of frames into segments, wherein a segment includes a plurality of frames;

for each segment, encoding the frames in the segment into at least two virtual frames that include a three-dimensional structure for the segment and an uncertainty associated with the segment.

10. The method of claim 9 wherein dividing includes:

identifying a base frame;

identifying feature points in the base frame; and

defining the segments such that every frame in a segment has at least a predetermined percentage of feature points identified in the base frame.

11. The method of claim 9 wherein the segments vary in length and wherein the length is associated with the number of frames in the segment.

12. The method of claim 9 further including:

identifying feature points in the sequence of two-dimensional frames;

estimating three-dimensional coordinates for the feature points; and

estimating camera rotation and translation for the feature points.

13. The method of claim 12 wherein estimating the three-dimensional coordinates includes applying a two-frame structure-from-motion algorithm to the sequence of two-dimensional frames.

14. The method of claim 9 further including:

dividing a segment into multiple frame pairs;

applying a two-frame structure-from-motion algorithm to the multiple frame pairs to create a plurality of local models; and

scaling the local models so that they are on a similar coordinate system.

15. The method of claim 14 wherein each of the multiple frame pairs includes a common base frame and one other frame in the segment.

16. The method of claim 15 further including interpolating frames between the multiple frame pairs.

17. The method of claim 9 wherein encoding includes:

choosing at least two frames in the segment that are at least a threshold number of frames apart;

for each of the at least two chosen frames, projecting a plurality of three-dimensional points into a corresponding virtual frame; and

for each of the at least two chosen frames, projecting an uncertainty into the corresponding virtual frame.

18. The method of claim 9 further including bundle adjusting the virtual frames from the segments to create a three-dimensional reconstruction.

19. The method of claim 9 further including identifying feature points in the frames by using motion estimation.

20. The method of claim 19 wherein the motion estimation includes:

creating a template block in a first frame including a feature point and neighboring pixels adjacent the feature point;

creating a search window used in a second frame; and

comparing an intensity difference between the search window and the template block to locate the feature point in the second frame.

21. The method of claim 9 wherein at most two virtual frames are used.

22. A computer-readable medium having computer-executable instructions for performing the method recited in claim 9.

23. A method of recovering a three-dimensional scene from a sequence of two-dimensional frames, comprising:

(a) segmenting the sequence of two-dimensional frames;

(b) identifying feature points in at least a first base frame in a first segment;

(c) analyzing a second frame in the segment to identify the feature points in the second frame;

(d) determining whether a threshold number of feature points from the base frame are identified in the second frame;

(e) if a threshold number of feature points are identified in the second frame, adding the second frame to the segment; and

(f) repeating (c) through (e) for subsequent frames until the number of feature points in a frame falls below the threshold number.

24. The method of claim 23 further including designating a frame that falls below the threshold number as a base frame in a second segment and repeating (b) through (e) for the second segment.

25. The method of claim 23 further including performing motion estimation to identify the feature points.

26. The method of claim 23 further including using corners as the feature points.

27. The method of claim 23 wherein the number of frames varies between segments.

28. The method of claim 23 further including creating two virtual key frames per segment.

29. The method of claim 28 further including bundle adjusting the virtual key frames of all the segments to obtain a three-dimensional reconstruction.

30. A computer-readable medium having computer-executable instructions for performing the method recited in claim 23.

31. In a method of recovering a three-dimensional scene from a sequence of two-dimensional frames, an improvement comprising dividing a long sequence of frames into segments and reducing the number of frames in each segment by representing the segments using between two and five representative frames per segment, wherein the representative frames are used to recover the three-dimensional scene and remaining frames are discarded so that the three-dimensional scene is effectively compressed.

32. The method of claim 31 wherein each of the representative frames have an uncertainty associated therewith.

33. The method of claim 31 wherein the long sequence includes over 75 frames.

34. The method of claim 31 wherein dividing the long sequence into segments includes identifying a base frame and tracking feature points between frames in the sequence and the base frame and ending a segment whenever a frame does not contain a predetermined threshold of feature points that are contained in the base frame.

35. The method of claim 31 further including performing a two-frame structure-from-motion algorithm on each of the segments to create a partial model.

36. A computer-readable medium having computer-executable instructions for performing a method comprising:

providing a sequence of two-dimensional frames;

dividing the sequence into segments;

calculating a partial model for each segment that includes three-dimensional coordinates and camera pose for features within the frames;

extracting virtual key frames from each partial model, the virtual key frames having three-dimensional coordinates for the frames and an uncertainty associated with the frames; and

bundle adjusting the virtual key frames to obtain a complete three-dimensional reconstruction of the two-dimensional frames.

37. An apparatus for recovering a three-dimensional scene from a sequence of two-dimensional frames by segmenting the frames, comprising:

means for capturing two-dimensional images;

means for dividing the sequence into segments;

means for calculating a partial model for each segment that includes three-dimensional coordinates and camera pose for features within the frames;

means for extracting virtual key frames from each partial model; and

means for bundle adjusting the virtual key frames to obtain a complete three-dimensional reconstruction of the two-dimensional frames.

WEBSTER'S II
New Riverside University Dictionary

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Table c

fon·ti·na (fŏn-tē'nə) n. [Ital.] A ripened cheese that originated in Italy.
food (fo͞od) n. [ME *fode* < OE *fōda*.] **1.** Material, usu. of plant or animal origin, containing or consisting of essential body nutrients, as carbohydrates, fats, proteins, vitamins, or minerals, taken in and assimilated by an organism to maintain growth and life. **2.** A specified kind of nourishment <breakfast *food*><plant *food*><cat *food*> **3.** Nourishment eaten in solid form. **4.** Something that nourishes in a way likened to physical nourishment.
food chain n. A succession of organisms in a community that constitutes a feeding chain in which food energy is transferred from one organism to another as each consumes a lower member and in turn is preyed upon by a higher member.
food poisoning n. Poisoning caused by ingesting food contaminated by natural toxins or bacteria, esp. bacteria of the genus *Staphylococcus*, and marked by vomiting, diarrhea, and prostration.
food processor n. An appliance having a container with interchangeable metal or plastic blades for processing food, as by slicing or shredding, at high speed.
food stamp n. A stamp issued by the government and sold or given to low-income persons to be redeemed for food.
food·stuff (fo͞od'stŭf') n. A substance that can be used or prepared for use as food.
food vacuole n. A vacuole in which phagocytized food is di[illegible]gested.
food web n. A complex of interrelated food chains in an ecologic[al] community.
foo·fa·raw (fo͞o'fə-rô') n. [Orig. unknown.] **1.** Excessive or fla[shy] ornamentation. **2.** A to-do over nothing.
fool (fo͞ol) n. [ME *fol* < OFr. < Lat. *follis*, bellows.] **1.** One deficie[nt] in judgment, sense, or understanding. **2.** One who acts unwisely [illegible] was a *fool* to have taken this job.> **3.** A member of a royal or [illegible] household who once entertained the court with jests and mimicr[y] [illegible] JESTER. **4.** One who has been or can be easily deceived or impo[sed] upon : DUPE <made a *fool* of me> **5.** *Chiefly Brit.* A dessert ma[de of] crushed, stewed fruit mixed with cream or custard and served [illegible] **6.** *Informal.* A person with a talent or enthusiasm for a certai[n ac]tivity <a *fool* for antique cars> **7.** *Obs.* A feeble-minded pers[on] [illegible] IDIOT. —*v.* **fooled, fool·ing, fools.** —*vt.* **1.** To deceive or [illegible] DUPE. **2.** To take unawares <We were sure they would fail, but [illegible] *fooled* us.> —*vi.* **1.** *Informal.* To engage in or amuse oneself [illegible] useless or trifling activity <just *fooling* around> **2.** To [illegible] tamper with aimlessly <shouldn't *fool* with matches> **3.** To [illegible] speak in jest : JOKE. **4.** To act or speak without but as if with pu[rpose]ful or harmful intent <I sounded angry, but I was only *fooli*[*ng*]> —**fool away.** To waste (time or money) foolishly : SQUANDER.
fool·er·y (fo͞o'lə-rē) n., pl. **-ies.** **1.** Foolish behavior or speech [illegible] instance of foolery : JEST.
fool·har·dy (fo͞ol'här'dē) *adj.* **-di·er, -di·est.** [ME *folhardi* [illegible] *fol hardi*, bold fool.] Unwisely bold or venturesome : RASH. [illegible] **har'di·ly** *adv.* —**fool'har'di·ness** *n.*
fool·ish (fo͞o'lĭsh) *adj.* **1.** Lacking good sense or judgment [illegible] <*foolish* remarks> **2. a.** Resulting from stupidity or [illegible] tion : UNWISE <a *foolish* decision> **b.** So senseless as to [illegible] able. **3.** Devoid of meaning or coherence : INANE <a *foolish* [illegible] **4.** Abashed : embarrassed. **5.** *Archaic.* Insignificant [illegible] —**fool'ish·ly** *adv.* —**fool'ish·ness** *n.*
★ **syns:** FOOLISH, ABSURD, BALMY, CRAZY, DIPPY, [illegible] SANE, LOONY, LUNATIC, MAD, NONSENSICAL, PREPOSTEROUS [illegible] TOMFOOL, WACKY, ZANY *adj.* *core meaning* : so senseless [illegible] laughable <a *foolish* attempt to cross the country on [illegible]
fool·proof (fo͞ol'pro͞of') *adj.* **1.** Designed so as to be impervious [illegible] human incompetence, error, or misuse <a *foolproof* [illegible] **2.** Always effective : INFALLIBLE <a *foolproof* ploy>
fools·cap (fo͞olz'kăp') n. [From the watermark of a fool's [cap and] bells orig. used for this paper.] **1.** A sheet of writing or [illegible] [approx.] 13 x 16 inches. **2.** A fool's cap.

stocking or high-topped boot enclosing the foot. **7.** A manner of moving : STEP <runs with a light *foot*> **8.** Foot soldiers. **9.** The attachment on a sewing machine that clamps down and guides the cloth. **10.** A metrical unit consisting of a stressed or unstressed syllable or syllables. **11.** A unit of length in the U.S. Customary and British Imperial systems, equal to $^1/_3$ yard or 12 inches. **12. foots.** Sediment that forms during the refining of oil and other liquids : DREGS. —*v.* **foot·ed, foot·ing, foots.** —*vi.* **1.** To go on foot : WALK. **2.** To dance. —*vt.* **1.** To go by foot over, on, or through : TREAD. **2.** To provide (e.g., a stocking) with a foot. **3.** To add (a column of numbers) and write the total at the bottom : TOTAL <*foot* up the bill> **4.** *Informal.* To pay <Can you *foot* the bill?> —**on foot.** Walking or standing. —**put (one's) best foot forward.** *Informal.* To make a good beginning or favorable first impression. —**put (one's) foot down.** *Informal.* To assert one's will emphatically. —**put (one's) foot in (one's) mouth.** *Informal.* To make a tactless or embarrassing blunder in speech.
foot·age (fo͝ot'ĭj) n. **1.** Length or extent, expressed in feet. **2.** A segment of motion-picture film, esp. a segment depicting a particular event or type of action <news *footage*><convention *footage*>
foot-and-mouth disease (fo͝ot'ən-mouth') n. An acute, highly contagious degenerative but usu. nonfatal viral disease of cattle and other cloven-hoofed animals, marked by fever and the eruption of vesicles around the mouth and hoofs.
foot·ball (fo͝ot'bôl') n. **1. a.** A game played by two teams of 11 players each on a rectangular 100-yard-long field with goal lines and posts at either end, the object being to gain possession of the ball and advance it in running or passing plays across the opponent's goal line. **b.** A similar game, popular in Canada, played by 12-man teams on a field 110 yards long. **c.** The inflated oval ball used in either of these games. **2.** *Chiefly Brit.* **a.** Rugby football. **b.** The ball used in Rugby football. **3.** *Chiefly Brit.* **a.** Soccer. **b.** The ball used in soccer. **4.** A problem or issue passed about among groups or persons without being settled <The court appointment became a political *football*.>
foot·board (fo͝ot'bôrd', -bōrd') n. **1.** A board or small raised platform on which to support or rest the feet, as in a carriage. **2.** An upright board across the foot of a bedstead.
foot brake n. A brake operated by foot pressure on a pedal.
foot·bridge (fo͝ot'brĭj') n. A pedestrian bridge.
foot-can·dle (fo͝ot'kăn'dl) n. *Physics.* The illumination of a surface one foot distant from a source of one candela, equal to one lumen per square foot.
foot·cloth (fo͝ot'klôth', -klŏth') n. **1.** A richly ornamented cloth draped over the back of a horse and touching the ground. **2.** *Obs.* A carpet or rug.
foot-drag·ging (fo͝ot'drăg'ĭng) n. Failure to take prompt or required action. —**foot'-drag'ger** n.
foot·ed (fo͝ot'ĭd) *adj.* **1.** Having a foot or feet. **2.** Having a given kind or number of feet <web-*footed*>
foot·er (fo͝ot'ər) n. **1.** A pedestrian. **2.** One measured by an indicated number of feet in height or length <a five-*footer*>
foot·fall (fo͝ot'fôl') n. **1.** A footstep. **2.** The sound of a footstep.
foot fault n. A fault against the server, as in tennis, called for failure to keep both feet behind the base line.
foot·gear (fo͝ot'gîr') n. Footwear.
foot·hill (fo͝ot'hĭl') n. A low hill close to the base of a mountain or mountain range.
foot·hold (fo͝ot'hōld') n. **1.** A place providing support for the foot in climbing or standing. **2.** A firm or secure position providing a base for further advancement.
foot·ing (fo͝ot'ĭng) n. **1.** Secure placement of the feet in standing or moving. **2.** A surface or the condition of a surface with respect to the ease with which one may walk or run on it <poor *footing* on the [illegible]> **3.** The supporting base or groundwork of a structure, as for a monument or wall. **4. a.** A basis : foundation <a business begun on [soun]d *footing*> **b.** A basis for social or business transactions with [others] : STANDING <on equal *footing* with other executives> [illegible]

foot·mark (fo͝ot'märk') n. A footprint.
foot·note (fo͝ot'nōt') n. **1.** A note placed at the bottom of a page or in a special separate section of a book or manuscript that comments on or cites a reference for a designated part of the text. **2.** Something related to but of lesser importance than a larger work or occurrence. —*vt.* **-not·ed, -not·ing, -notes.** To furnish with or comment on in footnotes.
foot·pace (fo͝ot'pās') n. **1.** A walking pace. **2.** A raised platform in a room, as for a lecturer : DAIS.
foot·pad (fo͝ot'păd') n. [FOOT + obs. *pad*, highwayman.] *Archaic.* A highwayman or street robber who operates on foot.
foot·path (fo͝ot'păth', -päth') n. A narrow path for persons on foot.
foot-pound (fo͝ot'pound') n. A unit of work equal to the work done by a force of one pound acting through a distance of one foot in the direction of the force.
foot-pound·al (fo͝ot'poun'dl) n. A unit of work equal to the work done by a force of one poundal acting through a distance of one foot in the direction of the force.
foot-pound-sec·ond (fo͝ot'pound'sĕk'ənd) *adj.* Of, relating to, or typical of a system of units based on the foot, the pound, and the second as the fundamental units of length, weight, and time.
foot·print (fo͝ot'prĭnt') n. An outline or indentation left by a foot on a surface.
foot·race (fo͝ot'rās') n. A race run on foot. —**foot'rac'ing** n.
foot·rest (fo͝ot'rĕst') n. A support on which to rest the feet.
foot·rope (fo͝ot'rōp') n. **1.** A rope attached to the lower border of a sail. **2.** A rope, rigged beneath a yard, for crew members to stand on during the reefing or furling of sail.
foot·rot (fo͝ot'rŏt') n. **1.** A degenerative infection of the feet in hoofed animals, esp. cattle or sheep, often causing loss of the hoof. **2.** A disease of plants in which the stem or trunk rots at its base.
foot soldier n. An infantry soldier.
foot·sore (fo͝ot'sôr', -sōr') *adj.* Having sore or tired feet from much walking. —**foot'sore'ness** n.
foot·stalk (fo͝ot'stôk') n. *Bot.* A supporting stalk, as a peduncle or pedicel.
foot·stall (fo͝ot'stôl') n. The pedestal or plinth of a pillar.
foot·step (fo͝ot'stĕp') n. **1. a.** A step with the foot. **b.** The distance covered by one step <a *footstep* away> **c.** The sound of a foot stepping. **2.** A footprint. **3.** A step up or down. —**follow in (someone's) footsteps.** To carry on the behavior, work, or tradition of (a predecessor).
foot·stone (fo͝ot'stōn') n. A marking stone at the foot of a grave.
foot·stool (fo͝ot'sto͞ol') n. A low stool.
foot·wall (fo͝ot'wôl') n. The mass of rock underlying a mineral deposit in a mine.
foot·way (fo͝ot'wā') n. A walk for pedestrians.
foot·wear (fo͝ot'wâr') n. Covering for the feet, as shoes or boots.
foot·work (fo͝ot'wûrk') n. **1.** The way in which the feet are used or maneuvered, as in boxing. **2.** Work involving moving around on foot : LEGWORK.
fop (fŏp) n. [ME, fool.] A man preoccupied with his clothes and manners : DANDY.
fop·per·y (fŏp'ə-rē) n., pl. **-ies.** The dress or manner of a fop.
fop·pish (fŏp'ĭsh) *adj.* Of, relating to, or typical of a fop : DANDIFIED. —**fop'pish·ly** *adv.* —**fop'pish·ness** *n.*
for (fôr; fər *when unstressed*) *prep.* [ME < OE.] **1. a.** —Used to indicate the object, aim, or purpose of an act or activity <trained *for* the priesthood><put the car up *for* sale><plans to run *for* President> **b.** —Used to indicate a destination <were headed *for* town> **2.** —Used to indicate the object of a desire, intention, or perception <an eye *for* good-looking things><eager *for* success> **3. a.** —Used to indicate the recipient or beneficiary of an act <prepared brunch *for* us> **b.** On behalf of <spoke *for* all the crew members> **c.** In favor of [illegible]

Webster's Third New International Dictionary

OF THE ENGLISH LANGUAGE

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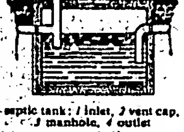
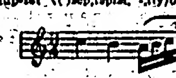
septic pneumonia *n* : [redacted]: septicemia marked by pneumonia esp. in young [redacted]s calves)
septic sore throat *n* : sore th[redacted] characterized by inflammation of the throat and pharynx with associated fever, marked prostration, and other evidences of toxemia and caused by infection with hemolytic streptococci
septic tank *n* : a tank in which the organic solid matter of continuously flowing sewage is deposited and retained until it has been disintegrated by anaerobic bacteria


septic tank: *1* inlet, *2* vent cap, *3* manhole, *4* outlet

sep·tième \(')se;tyem\ *n* -s [F, lit., seventh, fr. L *septimus*, fr. *septem* seven — more at SEVEN] : a mutation stop of 2⅔ and 1⅓ foot pitch on the manuals and 4⅔ foot pitch on the pedals
sep·tier \se'tyā\ *n* -s [F, alter. of *setier* — more at SETIER] : SETIER
sep·tif·ra·gal \(')sep;tifrəgəl\ *adj* [¹*sept-* + L *frag-* (stem of *frangere* to break) + E *-al* — more at BREAK] : breaking from the partitions — used of dehiscence in which the valves of a capsule or pod break away from the dissepiments — **sep·tif·ra·gal·ly** \-əlē\ *adv*
sep·tile \'sep,tīl, -,təl\ *adj* [ISV ¹*sept-* + *-ile*; prob. orig. formed in F] : of or relating to septa
sep·til·lion \(')sep;tilyən\ *n* -s *often attrib* [F, fr. ¹*sept-* + *-illion* (as in *million*)] — see NUMBER table
sep·ti·mal \'septəməl\ *adj* [L *septimus* seventh (fr. *septem* seven) + E *-al* — more at SEVEN] : based on the number seven
sep·time \'septəm, -,tēm\ *n* -s [L *septima*, fem. of *septimus* seventh; fr. its being the seventh parrying position] : a parry or guard position in fencing that defends the lower inside target with the hand to the left in a position of supination and the top of the blade directed at the opponent's knee — compare QUINTE
sep·ti·mole \'septə,mōl\ *also* **sep·tole** \-p,tōl\ *n* -s [*septimole* fr. L *septimus* seventh + E *-ole*; *septole* fr. ¹*sept-* + *-ole*] : SEPTUPLET
sept·insular \(')sept+\ *adj, usu cap* [¹*sept-* + *insular*] : of, relating to, or consisting of the seven Ionian islands ‹*Septinsular* Republic›
sep·ti·syllabic \;septə+\ *adj* [¹*sept-* + *syllabic*] : consisting of seven syllables
sep·ti·syllable \"+\ *n* [¹*sept-* + *syllable*] : a word of seven syllables
sep·ti·valent, *also* **sep·ta·valent** \;septə+\ *adj* [¹*sept-* + *valent*] : HEPTAVALENT
septleva *n* -s [F *sept-et-le-va*, lit., seven and the first stake] : a sum equal to seven times the amount of the first stake in a game of basset
septo- — see SEPT-
sep·to·basidium \;sep(,)tō+\ *n, cap* [NL, fr. ¹*sept-* + *basidium*] : a genus (the type of the family Septobasidiaceae) of smooth shelf fungi usu. having a well-developed sometimes thick-walled hypobasidium
sep·to·costa \;septə+\ *n* [NL, fr. ¹*sept-* + *costa*] : an external costa on the calyx of a coral that marks the position of or is a continuation of a radial septum
sep·to·cylindrical \;sep(,)tō+\ *adj* [¹*sept-* + *cylindrical*] : cylindrical with one or more cross septa ‹the ~ conidia of some fungi›
sep·to·gloe·um \,septə'glēəm\ *n, cap* [NL, fr. ¹*sept-* + *-gloeum* (fr. Gk *gloios* gum) — more at GLOEO-] : a form genus of fungi (order Melanconiales) having hyaline two-septate to several-septate and oblong conidia and including one member (*S. profusum*) that causes a leaf spot of elm and hazel
septole *var of* SEPTIMOLE
sep·to·let \,septə;let\ *n* -s [alter. (influenced by *-et* as in *septuplet*) of *septole*] : SEPTUPLET
sep·to·marginal \;sep(,)tō+\ *adj* [¹*sept-* + *marginal*] : of or relating to the margin of a septum
¹**sep·to·maxillary** \"+\ *adj* [¹*sept-* + *maxillary*] : of, relating to, or situated in the region of the nasal septum and the maxilla
²**septomaxillary** \"\ *n* -es : a small bone lying between the nasal septum and the maxilla in many amphibians and reptiles and in some birds
sep·to·nasal \;sep(,)tō+\ *adj* [¹*sept-* + *nasal*] : of, relating to, or situated in the region of the nasal septum
sep·to·ria \sep'tōrēə\ *n, cap* [NL, fr. ¹*sept-* + L *-oria* (fem. of *-orius* -ory)] : a form genus of imperfect fungi (family Sphaeropsidaceae) having hyaline elongate to threadlike septate spores formed in pycnidia on the leaves of the host and being known in many cases to be the imperfect stages of ascomycetous fungi of the genus *Mycosphaerella* — see HARD ROT
septa *pl of* SEPT
¹**sep·tu·age·nar·i·an** \(,)sep;t(y)üəjə;nerēən, ;septəwəj-, ;sepchəwəj-, ;septə,wəj-, ;sepchə,wəj-, -na(a)r-, -nār-\ *adj* [L *septuagenarius* septuagenary + E *-an*] : SEPTUAGENARY
²**septuagenarian** \"\ *n* -s : a person who is 70 or more but less than 80 years old
sep·tu·agenary \;septəwə;jenərē, -pchəw-, -;jēn-; -;wajə,nerē\ *adj* [L *septuagenarius*, fr. *septuageni* seventy each (fr. *septuaginta* seventy) + *-arius* -ary] **1** : based on the number 70 **2** : 70 or between 70 and 80 years old
sep·tu·a·ges·i·ma \,septəwə'jesəmə, -pchəw-, -jāzəmə\ *n* -s [ME *septuagesime*, *septuagesima*, fr. MF & LL; MF *septuagesime*, fr. LL *septuagesima*, fr. L, fem. of *septuagesimus* seventieth; fr. *septuaginta* seventy] **1** *obs* : the period of 70 days extending from the third Sunday before Lent to the Saturday after Easter **2** *or* **septuagesima sunday** *usu cap both Ss* : the third Sunday before Lent or the ninth before Easter in the church year observed by various branches of the Christian church
sep·tu·a·gint \sep't(y)üəjənt; 'septəwə,jint, -pchəw-\ *n* -s [L *septuaginta* seventy, fr. *septem* seven + *-ginta* (akin to L *-ginti* in *viginti* twenty) — more at SEVEN, VICENARY] **1** *usu cap* **a** : the 70 or 72 Jewish scholars at Alexandria held to have translated the Old Testament into Greek **b** [LL *Septuaginta*, fr. L *septuaginta* seventy] : a copy or edition of the Greek translation of the Old Testament including the Apocrypha prepared in the 3d and 2d centuries B.C. constituting the first vernacular translation of the Bible, designed to meet the needs of Greek-speaking Jews of Egypt unable to read their Scriptures in Hebrew, and still used in the Eastern Orthodox Church — symbol *LXX* **2** *sometimes cap* : a group of 70
sep·tu·a·gin·tal \(')sep;t(y)üə;jint³l, ;septəwə-, ;sepchəwə-\ *adj, usu cap* : of or relating to the Septuagint
sep·tu·la \'septələ, -pchə-\ *n, pl* **septu·lae** \-lē, -lī\ [NL, fr. ¹*sept-* + *-ula*] : one of the small perforations in the walls of the cells between adjacent bryozoan polyps
sep·tu·late \-lət, -,lāt\ *adj* [NL *septulum* + E *-ate*] *bot* : having imperfect or spurious septa
sep·tu·lum \'septələm\ *n, pl* **septu·la** \-lə\ [NL, dim. of *septum*] : a small septum
sep·tum \'septəm\ *n, pl* **sep·ta** \-tə\ *or* **septums** [NL, fr. L *septum*, *saeptum* enclosure, fence, wall, fr. *sepire*, *saepire* to hedge in, enclose, fr. *sepes*, *saepes* fence, hedge; akin to Gk *haimos* copse, thicket, *haimasia* stone wall] **1** : a dividing wall or membrane esp. : a wall separating two plant cells or two cavities or masses (as in a compound ovary or fruit) — called also *dissepiment* **b** : NASAL SEPTUM **c** : CRURAL SEPTUM **d** : a narrow dividing layer of rock material separating larger features of the rock fabric **e** : one of the transverse partitions dividing the shell of a cephalopod or a rhizopod into chambers **f** : one of the transverse partitions between the segments of an annelid **2** : one of the radial calcareous plates projecting into a calyculus of a coral
septum pel·lu·ci·dum \-pə'lüsədəm\ *n, pl* **septa pellucida** \-də\ [NL, transparent septum] : the thin double partition extending vertically from the lower surface of the corpus callosum to the fornix and neighboring parts, separating the

septem seven + *-uplus* (as in *quadruplus* quadrupl[redacted] SEVEN] **1** : consisting of seven : being seven time[redacted] as many : SEVENFOLD **2** : taken by sevens or in group[redacted]
²**septuple** \"\ *n* -s : a sum seven times as great as another : a sevenfold amount : the seventh multiple
³**septuple** *vt* **septupled**; **septupled**; **septupling** \-p(ə)liŋ\ : to make seven times as much or as many ~ *vi* : to become seven times as much or as many
sep·tup·let \(')sep;təplət, -;t(y)üp-, *sometimes* -;tep-\ *n* -s


septuplet 3

[¹*septuple* + *-et*] **1** : a combination of seven of a kind **2 a** : one of seven offspring born at one birth **b** **septuplets** *pl* : a group of seven such offspring **3** : a group of seven musical notes to be played in the time of four or six of the same value — called also *septimole*, *septolet*
¹**sep·tu·pli·cate** \(')sep;t(y)üplə,kət, -lēk-, *sometimes* -lə,kāt\ *adj* [ML *septuplicatus*, past part. of *septuplicare* to multiply by seven, fr. LL *septuplus* septuple, after such pairs as L *quadruplus* quadruple : *quadruplicare* to quadruple] : made in seven identical copies : SEVENFOLD
²**septuplicate** \"\ *n* -s **1** : a seventh thing like six others of the same kind **2** : seven copies all alike — used with *in* ‹typed in ~›
³**sep·tu·pli·cate** \-lə,kāt\ *vt* -ED/-ING/-S : to multiply by seven : reproduce six times : SEPTUPLE; *specif* : to make at one time an original and six carbon copies
¹**sep·ul·cher** *or* **sep·ul·chre** \'sepəlkə(r)\ *archaic* sə'p-\ *n* -s [ME *sepulcre*, fr. OF, fr. L *sepulcrum*, *sepulchrum*, fr. *sepelire* to bury; akin to Gk *hepein* to care for, prepare, Skt *saparati* he seeks after, courts, honors, *saparyati* he pays homage, worships] **1 a** : a place for the interment of a dead body : GRAVE, TOMB **b** : a final end or resting place : REPOSITORY, TERMINUS ‹my heart ... shall be thy ~ —Shak.› ‹of all ... French hopes —F.L.Schuman› **2 a** : a receptacle for religious relics esp. in an altar **b** : EASTER SEPULCHER
²**sepulcher** *or* **sepulchre** \"\ *vt* -ED/-ING/-S : to place or receive in a sepulcher : BURY, ENTOMB
se·pul·chral \sə'pəlkrəl, se'p-\ *adj* [L *sepulcralis*, fr. *sepulcrum* sepulcher + *-alis* -al] **1** : of, relating to, or serving as a sepulcher or as a memorial to the dead : MORTUARY ‹~ inscriptions› ‹the ~ darkness of the catacombs —Nathaniel Hawthorne› ‹erect ~ monuments in the church —Nikolaus Pevsner› **2 a** : suited to or suggestive of burial rites : having a funereal quality ‹a ~ whisper› ‹rows of empty benches in the dusk gave the room a somewhat ~ aspect —Hanns Sachs› **b** : emanating from or as if from the tomb ‹the hollow, ~ tone of editorial comment —G.W.Johnson› — **se·pul·chral·ly** \-rəlē\ *adv*
se·pul·tur·al \sə'pəlch(ə)rəl, ;sepəl;chürəl\ *adj* [¹*sepulture* + *-al*] *archaic* : SEPULCHRAL
¹**sep·ul·ture** \'sepəlchər, -,chü(ə)r\ *n* -s [ME, fr. OF, fr. L *sepultura*, fr. *sepultus* (past part. of *sepelire* to bury) + *-ura* -ure] **1** : BURIAL **2** : SEPULCHER
²**sepulture** \"\ *vt* -ED/-ING/-S : to place in or as if in a grave : BURY
seq *abbr* **1** sequel **2** sequence **3** [L *sequens*, *sequentes*, *sequentia*] the following **4** [L *sequitur*] it follows
seqq *abbr* **1** [L *sequentes*, *sequentia*] the following **2** [L *sequentibus*] in the following places
seqq *abbr* [L *sequitur*] it follows
se·qua·cious \sə'kwāshəs, sē'k-\ *adj* [L *sequac-*, *sequax* sequacious (fr. *sequi* to follow) + E *-ous*] **1 a** *archaic* : inclined to follow : SUBSERVIENT, TRACTABLE **b** : inclined to be servile : IMITATIVE, OBSEQUIOUS **2** *obs* : characterized by malleability : DUCTILE, PLIABLE **3** : logically sequent
se·qua·cious·ness *n* -ES : SEQUACITY
se·quac·i·ty \sə'kwasəd·ē\ *n* -es [LL *sequacitas*, fr. L *sequac-*, *sequax* inclined to follow, sequacious + *-itas* -ity] : the quality or state of being sequacious : disposition to follow
se·qua·ni \'sekwə,nī, -nē; ;sikwə,nē\ *n pl, cap* [L] : a Celtic people of ancient Gaul inhabiting a region around the sources of the Seine
se·quel \'sēkwəl\ *n* -s [ME *sequel*, *sequele*, fr. MF *sequelle*, fr. L *sequella*, *sequela*, fr. *sequi* to follow — more at SUE] **1** *obs* **a** : a member of a retinue : FOLLOWER; RETAINER — usu. used in pl. ‹friends, adherents, and ~s, should be comprehended in the truce —John Speed› **b** : SUCCESSION, HEIRS ‹his daughter first, and, in ~, all —Shak.› **2** : something that follows naturally from an antecedent cause : CONSEQUENCE, RESULT ‹higher prices as a ~ to rising production costs› **b** *obs* : a logical inference ‹so fareth it with the bodies and, by ~ with the souls —Thomas Walkington› **c** : SEQUELA 1 ‹gangrene is ... a ~ of wounds —Robert Chawner› **3 a** : the next in an unfolding series (as of events) : subsequent development ‹powered flight as the evolutionary ~ to gliding› **b** : the next installment (as of a speech or narrative) : CONTINUATION; *esp* : a literary work continuing the course of a narrative begun in a preceding one ‹the hero performs even more astonishing feats in the ~› **4** : an allowance of meal or other small perquisite made in thirlage to the servants of the dominant mill for actual or nominal services in grinding — usu. used in pl. **syn** see EFFECT
se·que·la \sə'kwelə, sē'k-, se'k-, -wēlə\ *n, pl* **sequelae** \-(,)lē\ [NL, fr. L, sequel] **1** : an aftereffect of disease or injury ‹enteritis ... as a ~ of indigestion —F.B.Hadley› ‹the necessity for frequent blood counts to avoid serious *sequelae* —G.F.Dick› **2** : a secondary result : CONSEQUENCE ‹the poisonous *sequelae* of war —R.M.MacIver›
¹**se·quence** \'sēkwən(t)s, -,kwen-\ *n* -s [ME, fr. ML *sequentia*, fr. LL, succession, state or fact of following, fr. L *sequent-*, *sequens* (pres. part. of *sequi* to follow) + *-ia* -y] **1** : a hymn or rhythm having no regular meter read or sung between the gradual and the Gospel on certain occasions as part of a Christian liturgical service (as in Roman Catholic and Anglican churches) — called also *prose* **2** : a continuous or connected series as **a** : a group of similar or related elements ‹a ~ of market fluctuations› ‹a photo ~› ‹bringing ... a ~ of musicals to Sacramento —*Fortnight*› ‹the city spreads over a ~ of low hills —*Amer. Guide Series: Texas*›; *specif* : an extended series of poems united by a single theme ‹sonnet ~› **b** : three or more playing cards usu. of the same suit in consecutive order of rank (as jack, ten, nine, eight, seven) **c** : a succession of repetitions of a musical phrase each in a new position ‹rising chromatic ~› — compare ROSALIA **d** : a mathematical aggregate ordered in the same manner as the positive integers — compare SERIES 2 **e** : a planned program of courses ‹a four-year ~ in social studies —J.B.Conant› **f** *archaeol* (1) : a set of components occurring in successive strata, preferably in one site ‹a local ~› (2) : a group of local sequences consolidated into one of larger scope ‹a cultural ~› **g** (1) : a section of a motion picture consisting of a succession of related shots or scenes in which a single subject or a single phase of a story is developed ‹the ... roller-coaster ... in *Cinerama* —Lloyd Shearer› (2) : a self-sufficient combination of dance movements permitting of further development, or a movement series with repetition of a theme on an ever lowered or heightened plane of space or dynamic intensity (3) : EPISODE ‹the ~ from which the book takes its title —*Times Lit. Supp.*› ‹minute rehearsals of each ~ in the coronation ceremony —Blake Ehrlich› **h** (1) : an agreed or keyed succession in cryptography (2) : KEYING SEQUENCE (3) : an arrangement of the alphabet in cryptology **3 a** (1) : a chronological succession ‹birds have no prevision ... of the ~ of the seasons —E.A.Armstrong› (2) : a succession of geologic events, processes, or formations in chronologic order; *esp* : STRATIGRAPHIC SEQUENCE **b** (1) : a methodical arrangement or consecutive order ‹a ... ~ whereby he gets the apartment three days a week; she gets it twice —Lewis Nichols› ‹the ~ in

subordinate verbs (as in indirect discourse, conditional sentences)› (4) : the order in which portions of a recording are placed on a series of phonograph records — compare AUTOMATIC SEQUENCE **4 a** : a natural result or logical inference : SEQUEL ‹action is ~ to ... sincere idealism —*Times Lit. Supp.*› ‹the order of successional stages ... has been reconstructed by the methods of inference and ~ —*Ecology*› **b** : a subsequent development ‹everybody was caught up in a succession of ~s —*Time*› **c** : the order in which events are connected or related in time : simple succession; *esp* : the connection of antecedent and consequent in a temporal series apart from any causal necessity ‹the reactions of chemical agents may be conceived as merely invariable ~s› **5** : the quality or state of being sequent : continuity between parts : CONSECUTIVENESS, PROGRESSION ‹narrative ~› ‹formal ~ is useful to the architecture of public buildings because it helps to direct the visitor› ‹~ in learning depends upon continuity of growth in the learner —Dora Smith›
²**sequence** \"\ *vt* -ED/-ING/-S : to arrange in a sequence
se·quenc·er \-ənsə(r), -en(t)s-\ *n* -s [¹*sequence* + *-er*] **1** : a book of liturgical sequences **2** : any of various devices for arranging items (as pieces of information or the events in launching a rocket) into or separating items (as amino acids from protein) within a sequence
sequenciary *or* **sequentiary** *n* -es [ML *sequentiarium*, fr. *sequentia* + L *-arius* -ary] : SEQUENCER 1
se·quen·cy \'sēkwənsē\ *n* -es [LL *sequentia*] : SEQUENCE
¹**se·quent** \'sēkwənt\ *adj* [L *sequent-*, *sequens*, pres. part. of *sequi* to follow — more at SUE] **1** : occurring in sequence : ENSUING, CONSECUTIVE **2** : following as a result : CONSEQUENT
²**sequent** \"\ *n* -s **1** *obs* : one of a sequence; *esp* : a member of a retinue ‹a letter to a ~ of the stranger queen's —Shak.› **2** : CONSEQUENCE, SEQUEL ‹I adopt the mode of action, and the expected ... actually follows —C.I.Lewis›
se·quen·tial \sə'kwenchəl, (')sē'k-\ *adj* [LL *sequentia* sequence + E *-al* — more at SEQUENCE] **1 a** : occurring as a sequela of disease or injury **b** : of, relating to, or forming a sequence : CONSECUTIVE, SERIAL ‹combination of two ~ courses into one —S.L.Pressey› ‹set forth the essential facts ... in a well ordered, ~ manner —*N.Y. Herald Tribune*› ‹the ... Neolithic setting for which ~ stages have been most fully revealed —H.B.Collins› **c** : having the form or character of a musical sequence ‹~ arpeggio› **2 a** : occurring without interruption : CONTINUOUS **b** : relating to or based on a method of testing a statistical hypothesis that involves examination of a sequence of samples for each of which the decision is made to accept or reject the hypothesis or to continue sampling **3** : occurring as a result : CONSEQUENT — **se·quen·tial·ly** \-ch(ə)lē, -li\ *adv*
sequential system *n* : a system of color television based on the successive showing of the three primary colors as dots, lines, or rapidly succeeding whole pictures so that through persistence of vision the colors appear in their proper proportions
¹**se·ques·ter** \sə'kwestə(r), sē'k-\ *vb* -ED/-ING/-S [ME *sequestren*, fr. MF *sequestrer*, fr. LL *sequestrare* to set aside for safekeeping, surrender, remove, separate, fr. L *sequester* depositary, trustee; akin to L *sequi* to follow — more at SUE] *vt* **1 a** : to set apart : separate for a special purpose : REMOVE, SEGREGATE ‹the dentist must ~ with a rubber dam the tooth he is working on —*New Yorker*› **b** *obs* : to deprive of membership (as in a church) or of public office or station ‹was ~ed from parliament —David Hume †1776› **c** : to hide from public view : withdraw from circulation : SECLUDE, SECRETE ‹old houses ... ~ed under leafy boughs —*Amer. Guide Series: Vt.*› ‹no crusading idealist ... ever thought it right to ~ himself in an estate —Norman Thomas› **2 a** : to seize esp. by public authority : CONFISCATE ‹police continued to uncover and ~ ... arms and ammunition —R.G.Woolbert› **b** (1) : to take (property) from the possession of one or more parties to a controversy and put into the possession of a third party until profits have paid an obligation or until the owner has performed a decree of court or clears himself of contempt (2) *international law* : to appropriate under the right of preemption **3** : to bind (as a metal or metal ion) in the form of a soluble complex or chelate by adding a suitable reagent for the purpose of preventing precipitation in water solution by chemical agents that would normally bring it about, of solubilizing precipitates already formed, or of otherwise suppressing undesired chemical or biological activity ‹~ calcium and magnesium ions in the softening of hard water› ~ *vi* **1** *archaic* : to withdraw into seclusion : RETIRE **2** : to disclaim legal responsibility
²**sequester** \"\ *n* -s [L] **1** *Roman & civil law* : a depositary of property pending the settlement of a dispute as to its ownership : a receiver appointed by the court **2** [F *séquestre*, fr. L *sequestrum* sequestration, deposit, fr. *sequester* depositary] *obs* : SEPARATION ‹this hand of yours requires a ~ from liberty —Shak.› **3** [NL *sequestrum*] : SEQUESTRUM
sequestered *adj* [fr. past part. of ¹*sequester*] **1** : cut off from companionship or congenial surroundings : ISOLATED, SEGREGATED ‹a poor ~ stag that from the hunters ... had taken a hurt —Shak.› **2 a** : CONFISCATED, IMPOUNDED ‹when the royal officers in Philadelphia seized fifty pipes of Madeira ... a mob assaulted them and stole the ~ goods —C.A. & Mary Beard› **b** *archaic* : deprived of privilege or property : DISPOSSESSED **3 a** : withdrawn from public view : SHELTERED, SECLUDED ‹sat close together ... in the ~ pergola —L.C. Douglas› **b** : living the life of a recluse : SOLITARY
sequestra *pl of* SEQUESTRUM
se·ques·tra·ble \-trəbəl\ *adj* [¹*sequester* + *-able*] *archaic* : liable to exclusion or seizure
se·ques·trant \-trənt\ *n* -s [¹*sequester* + *-ant*] : a sequestering agent (as a sodium phosphate glass, a salt of ethylenediaminetetraacetic acid, or citric acid)
¹**se·ques·trate** \sə'kwe,strāt, sē'k-, 'sēkwə,s-, 'sekwə,s-; *usu* -ād+V\ *adj* [ME, fr. LL *sequestratus*, past part. of *sequestrare* to remove, separate] *archaic* : SEQUESTERED
²**sequestrate** \"\ *vb* -ED/-ING/-S [LL *sequestratus*, past part. of *sequestrare*] *vt* **1** : SEQUESTER **2** : to form a sequestrum in ~ *vi* : to form a sequestrum
se·ques·tra·tion \,sēkwə'strāshən, ,sekwə-, sə,kwes'-\ *n* -s [ME *sequestracion*, fr. LL *sequestration-*, *sequestratio*, fr. *sequestratus* (past part. of *sequestrare* to remove, separate) + *-ion-*, *-io* -ion — more at SEQUESTER] **1 a** : an act or instance of cutting off : EXCLUSION, SEPARATION ‹forced into retirement by parliamentary ~ —Douglas Bush› **b** : the quality or state of being sequestered : ISOLATION, SECLUSION ‹lonely ~ on an island —*Time*› **2** : the separation or removal of property from a person in possession of it in order that the property or the proceeds thereof may be dealt with as a court or other competent authority may direct: as **a** : the authorization of a sheriff or commissioners to take into custody the property of a defendant who is in contempt or its rents and profits until he complies with the orders of a court **b** *English eccl. law* : an attachment of a vacant benefice usu. granted by a bishop to church wardens for the management of its offices during the vacancy **c** *civil law* : a deposit whereby a neutral depositary agrees to hold property in litigation and to restore it to the party to whom it is adjudged to belong **d** *Scots law* : the appropriation of the property of a bankrupt in order to divide it among his creditors **e** *international law* : the seizure of the property of an individual for use by the state; *esp* : the seizure by a belligerent power of debts due from its subjects to the enemy or of property subject to the right of preemption **f** *probate law* : the subjection of a renounced interest to judicial management for distribution as the testator would have desired if he had in mind the renunciation of the interest he tried to create **3** : a seizure of property esp. by public authority : CONFISCATION ‹the taxation and ~ he suffered during and after the Civil War ... brought him into debt —J.B.Leishman› **4** : the formation of a sequestrum **5** : the process of sequestering or result of being sequestered ‹in soils various minor elements such as copper, zinc, and